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**SUMMARY**

Since early 1995, the Technology Development and Transfer (TD&T) Committee of DOE's Environmental Management Advisory Board (EMAB) has been considering issues faced by EM's technology development and deployment program. This testimony highlights two observations and five recommendations:

- Overall, EM has responded positively to the TD&T Committee's advice.
- EM's technology program operates in a difficult marketplace.
- EM could benefit from an internally coupled technology development and deployment system.
- Better performance metrics for EM's technology program are likely to yield improved results.
- Rigorous application by EM of its Gate Model evaluation criteria to technologies in the development pipeline can improve decision-making.
- The concept of the Technology Deployment Initiative (TDI) is sound and should be supported.
- Emphasis on multi-site applications of technologies will maximize return on

investment.

## **STATEMENT**

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to testify today on the Department of Energy's Environmental Management (EM) technology development and deployment program. I believe this is a very significant program. Not only can it address DOE's most urgent environmental clean-up needs over the next ten years (and beyond), but it also has the potential to impact in a positive way the evolving direction of the nation's environmental industry.

I am here in my capacity as Chairman of the Committee on Technology Development and Transfer (TD&T) of the EM Advisory Board (EMAB), a position I have held since Al Alm offered it to me in December 1994, when he was Co-Chair of EMAB. I also serve on EMAB's Science Committee, and in November 1996, I was appointed to the full Board. I am also proud to have the distinction of serving on EPA's Science Advisory Board, an appointment I recently received. My experience with the environmental industry, domestically and internationally, spans over 20 years. For your information, I have appended a one-page summary of my resume to this statement.

As you know, EMAB is comprised of about 25 stakeholders from a wide cross-section of experience who provide independent advice to EM senior management on a variety of relevant issues. In turn, the TD&T Committee is composed of about a dozen independent and highly experienced individuals with extensive knowledge of the environmental industry and related regulatory issues.

While I take full responsibility for my testimony, I am particularly honored to represent the views of the TD&T Committee at this hearing. Members of this Committee have worked diligently over the past two and one-half years, not only to understand technology development and deployment problems inside EM, but also to suggest potential solutions. In this effort, we have appreciated the high level of cooperation received from all levels within EM.

To assist your understanding of my perspective, I would like relate a discussion I had with Al Alm when he called me about 30 months ago to ask if I would accept the job of organizing and chairing the TD&T Committee. I told him I did not want to lead a Committee that would merely analyze problems and come forward with easily dismissed recommendations. Rather, I wanted to put together a group of very experienced individuals committed to making a difference. I wanted a committee that could work with EM to develop "implementable" solutions. Mr. Alm accepted my conditions, and the Committee's contributions speak for themselves.

The results of the Committee's work over the past two years have been well documented in the minutes of our meetings, as well as in our Committee reports and resolutions which have been adopted by the full EMAB. EM has provided these materials to the Committee on Commerce, and so our views are well known to the staff of the Subcommittee.

Thus, in my testimony, I will focus on only a few key points to maximize the opportunity for questions. I would like to discuss briefly two observations and then offer five recommendations. If it would be useful to the Subcommittee, additional

details can be provided for the record at a later date.

**Overall, EM has responded positively to the TD&T Committee's advice.**

In our work, the TD&T Committee has identified both primary and secondary barriers to the development and deployment of environmental technologies by DOE. Primary barriers are those that DOE can directly affect by its actions, and so most of our attention has been directed to these. Additionally, the Committee has carried out several studies and offered a series of recommendations for overcoming these barriers.

I am pleased to report that, overall, EM has responded positively to our advice and has taken specific actions to address the barriers. A few examples:

- a. The definition of DOE technology needs across the Complex continues to improve. They are becoming more specific and are being tied to priorities, waste streams, and waste units.
- b. The linkage between technology development and technology deployment efforts has been significantly strengthened by the work of the Focus Areas and Site Technology Coordinating Groups, among others.
- c. More information is available on the performance and cost of emerging technologies through the completion of demonstrations whose purpose was generating such information.
- d. There is greater awareness about the performance of available technologies, including their ability to address specific EM problems.

- e. Greater emphasis is being placed on defining performance-based criteria for acceptance of new technologies. This is requiring EM to focus on defining desired end-states for their waste units.
- f. Efforts have been initiated to facilitate site-specific and multi-state stakeholder and regulatory approval of new technologies.
- g. More efforts are evident to identify and incorporate applicable private sector technologies within the DOE Complex.
- h. There is greater emphasis on "deployment" (not just "demonstration") of technologies in the field, including multi-site use.

While many of these efforts are still at an early stage and have not yet fully borne fruit, I think they are on the right track and likely to yield many positive results.

**EM's technology program operates in a difficult marketplace.**

In trying to judge the success of EM's technology development-deployment program, it is important to understand the level of success private sector technology development programs have had outside the government market. In other words, how has the private sector environmental industry in the United States fared in developing and deploying innovative technologies?

In fact, the record has been far from stellar outside the DOE. Many of the same inherent barriers (i.e., regulatory, stakeholder, economic, risk-averse buyers, etc.) operate there to limit the ability of emerging technologies to be successfully commercialized. The time from inception of a development program for a specific technology to its ultimate acceptance by the marketplace has proven to be far

longer than anyone originally imagined. Expected development cycles of three to five years for a technology to reach commercial acceptance have consistently proven to be optimistic by at least two years (and often more!). This is primarily

related to the time required to satisfy regulators, stakeholders, and reluctant customers by obtaining additional performance and cost data.

These circumstances have frustrated many environmental clean-up technology developers in this country and caused them to fall prey to the well-known "Valley of Death." In fact, it is well accepted that expanded development times have driven many potential developers from the field to seek more lucrative areas. Many clean-up technologies have been unable to secure commercial acceptance on a sustaining basis in time frames of seven to ten years or more.

The venture capital community is reluctant to invest in environmental technology companies because of the inherent difficulties in commercializing new technologies in this field. There are few examples of companies with a track record of consistent commercial success.

Viewed within this broader context, and recognizing the additional problem within DOE that site contractors often have vested interests in resisting new technologies, the EM record of technology deployments to date is not out of line. The EM development program started officially in 1989 and is now about eight years old. Thus, by standard measures, the program should be on the verge of yielding a number of technologies into the deployment (i.e., not demonstration) arena. Judging from the number of technologies that have passed the Gate 4 development stage, there are many technologies now poised for deployment. The true test will be to get them deployed, not merely at a single site, but rather at a number of sites having similar problems.

Given these observations, I would like to offer a series of recommendations

for improving the EM technology development and deployment program.

**EM could benefit from an internally coupled technology development and deployment system.**

The TD&T Committee has always recognized that technology development and deployment is an EM-wide issue. Accordingly, the Committee has never focused its efforts exclusively on the work of EM-50, the Office of Science and Technology (OST), whose primary responsibility is technology development, not deployment. The Committee has also concerned itself with other offices in EM, primarily EM-40, the Office of Environmental Restoration, whose primary responsibility is site clean-up, and EM-30, the Office of Waste Management, which has the lead on waste treatment. In our view, it is EM-30 and EM-40 people, especially at the sites rather than Headquarters, who have, together with their contractor counterparts, ultimate responsibility to deploy the new technologies successfully developed by EM-50 and other parties.

Coupling development and deployment programs in a systems context would be the ideal approach, but this is not the current situation in EM. EM-50 development programs have traditionally focused almost exclusively on ***technical factors*** related to a specific technology. Consequently, there has been some difficulty in securing their acceptance by EM-30 and EM-40 field personnel at specific sites, because a myriad of ***non-technical factors*** (such as stakeholder and regulatory acceptance, life cycle cost, worker health and safety, implementation schedule, etc.) must still be addressed for which complete information is not



provided. Thus, there is a general disincentive to accept these technologies, unless that information is available and suitable to the site context.

Bridging this current information gap is precisely where the proposed Technology Deployment Initiative (TDI) is directed and one of the principal reasons why our Committee supports the concept of this program.

Clearly, an ideal system would require the smooth, seamless, and cooperative operation of EM offices, in spite of differences in their focus and priorities. EM-50 would focus on developing and providing the full range of relevant information on "improved" technologies that can meet priority EM needs in a timely manner. EM-30 and EM-40 would focus on identifying and incorporating any improved technology, whether from EM-50 or some other source, that can reduce baseline costs or solve a previously unsolvable problem in a timely manner.

The success of any technology development program, including the rate at which its technologies are being deployed, should be considered within a systems perspective. For that reason, the TD&T Committee will continue to address development and deployment on an EM-wide, rather than an office, basis and structure its initiatives and recommendations accordingly.

**Better performance metrics for EM's technology program are likely to yield improved results.**

While many individual elements of a technology development-deployment system can be discerned within EM (i.e., Gate Model, Focus Areas, Site Technology Coordinating Groups, etc.), linking of these elements into a cohesive system is yet to be done. More importantly, the TD&T Committee has found it difficult to track the progress that EM has made. Historical performance measures used by EM

relative to technology have tended to measure "activities" rather than desired "outcomes" or "results."

The establishment of performance measures can be a useful management tool to focus employee priorities. The current absence of a performance based tracking system within EM that monitors technology development as well as deployment is a serious deficiency. Performance measures should relate to desired results, and in this case, the measures should be built around general categories that include tracking basic funding and project parameters by technology but also include tracking environmental and economic benefits achieved.

In view of the requirements of the Government Performance and Results Act, it would be highly desirable for EM's technology program performance metrics to tie into DOE's overall metrics.

**Rigorous application by EM of its Gate Model evaluation criteria to technologies in the development pipeline can improve decision-making.**

The Gate Model developed by EM-50 defines a series of Gates from 1 to 6 that can be used to indicate the stage of development of an environmental technology. A set of criteria have been defined for each gate that include both technical and non-technical factors essential to successful development and eventual deployment. Rigorous and independent application of these criteria can be used to determine whether a technology is likely to meet its development goals, as well as what other activities must be performed to increase its chances of success.

In other words, the criteria can be used as a decision-making framework to

guide the development of a technology. Where a technology is successfully satisfying the gate criteria as it moves along the development pipeline, it justifies continued support. Where a technology is unable to meet certain criteria, either a re-focused effort is called for, or further funding should cease.

By rigorous application of these criteria, technologies that reach Gates 5 and 6 will have had to demonstrate a range of specific technical, economic, environmental, stakeholder, and deployment advantages (or they would not have reached that stage of development). The requirement to demonstrate comparative advantages over baseline technologies will greatly accelerate their acceptance.

While there have been some attempts by EM to use the Gate Model criteria, these attempts have not been consistent or thorough, and they have not been used as part of an EM-wide decision-making framework. In times like the present when budgets are under pressure, I believe that use of these criteria in a decision-making mode would yield substantial dividends in deciding which technologies to continue funding and which to terminate.

**The concept of the Technology Deployment Initiative (TDI) is sound and should be supported**

As previously indicated, the TDI addresses the information gap that currently exists between the end of a typical technology development effort and the deployment of a technology at a site. In effect, TDI is encouraging technology providers and sites to work more closely together toward a common clean-up goal.

Viewed from our perspective, TDI is also another way to encourage positive

culture change in the DOE Complex. The TD&T Committee has reviewed the concept of TDI and generally supports it. A resolution to this effect was developed by the Committee and approved unanimously by the full EMAB at its last meeting on April 10, 1997. A copy of this resolution is appended to this statement. Note that the Committee added three provisos to its endorsement of TDI that support the work of the Focus Areas, encourage the involvement of the private sector in TDI, and request that the stated evaluation criteria be rigorously applied.

**Emphasis on multi-site applications of technologies will maximize return on investment.**

Finally, it is clear that a successful TDI will lead to multi-site deployment of the most appropriate technologies and that this will maximize return on EM's past investment. TDI encourages addressing not only site specific issues but also issues that cut across more than one site. Ultimately these issues will have to be solved in order to secure the maximum benefit from the investments made to date. We do not see TDI as a "silver bullet," but it is at least a "silver dart."

I hope my testimony today has been useful to the Subcommittee, and I would be happy to answer any questions you may have.